

# Overview of the DOE Heavy Vehicle Advanced Development Program

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CENTER FOR TRANSPORTATION TECHNOLOGIES AND SYSTEMS



# Sponsored by the U.S. Department of Energy Office of Transportation Technologies



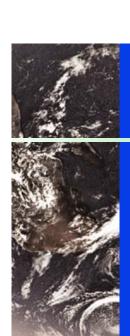


Office of Heavy Vehicle Technologies
Fuels and Lubricants Technologies
Steve Goguen, Program Manager

Enabling Technologies

Engine R&D

Advanced Development



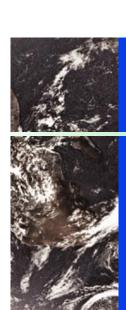
# **Advanced Development Program Objective**

- To develop and test truck and bus technologies that...
  - Reduce dependence on imported oil
  - Improve air quality



# **Advanced Development Program Approach**

- Pre-production field development
- Test fleets



# **Pre-Production Field Development**

- Vehicles are fitted with new prototype engine.
- Vehicles are operated in normal revenue service.
- Modifications are made to the engines and fuel systems to overcome problems.
- This experience is used to develop the production engine.



# **Praxair LNG Line-Haul Trucks**



Number of trucks in project: 3 LNG, 1 diesel control

Chass: Freightliner FLD120, Class 8 tractor Engine: Prototype Detroit Diesel Series 60G Fuel system: LNG, dual MVE 120-gallon tanks

Status: Trucks have been in operation since April 1995.



# Los Angeles Times CNG Line-Haul Truck



Number of trucks in project: 1 CNG, 1 diesel control

Chass: Ford LTLA 9000, Class 8 tractor

Engine: Prototype Detroit Diesel Series 60G

Fuel system: CNG, eight cylinders

Status: Truck has been in operation since November 1994.



# **Unocal Corporation LNG Line-Haul Truck**



Number of trucks in project: 1 LNG, 1 diesel control

Chassis: Peterbilt 379, Class 8 tractor

Engine: Prototype Detroit Diesel Series 60G

Fuel system: LNG, single MVE 128-gallon tank

Status: Truck was in operation from August 1995 to March 1997.



# Wal-Mart Stores, Inc., LNG Line-Haul Truck



Number of trucks in project: 1 LNG, 1 diesel control

Chassis: Navistar 9600 Cabover, Class 8 tractor

Engine: Prototype Detroit Diesel Series 60G

Fuel system: LNG, dual MVE 120-gallon tanks

Status: Truck was in operation from June 1995 to November 1996.



# **Con-Way Western Express LNG City Tractors**



Number of trucks in project: 2 LNG, 2 diesel controls

Chassis: Ford LN8000, Class 8 city tractor

Engine: Cummins C Series natural gas engine

Fuel system: LNG, dual MVE tanks

Status: Trucks have been in operation since October 1995.



# **Chambers Development Company, Inc., LNG Refuse Haulers**



Number of trucks in project: 7 LNG, 1 diesel control

Chassis: Mack refuse hauler

Engine: Prototype Mack E7 natural gas Fuel system: LNG, dual MVE tanks

Status: First truck was delivered to the site in March 1997.



# **Houston Airgas LNG Straight Trucks**



Number of trucks in project: 2 LNG, 1 diesel control

Chassis: Freightliner FLD 112 Class 8 truck

Engine: Detroit Diesel Series 50G, high horsepower

Fuel system: LNG

Status: Trucks have been in operation since April 1996.



### **AG Processing Biodiesel Blend Line-Haul Trucks**



Number of trucks in project: 6 BD35, 3 diesel controls

Chassis: Freightliner FLD120 Class 8 line-haul truck; Kenworth T-800 Class 8 line-haul truck

Engines: Detroit Diesel Series 60; Cummins 855

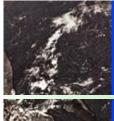
Fuel system: 35% soy biodiesel blend

Status: Trucks have been in operation since January 1995.



### **Test Fleets**

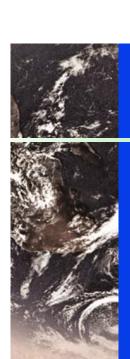
- Five or more alternative fuel trucks or buses at each site
- Emissions-certified engines
- Emissions measured by West Virginia University
- Track refueling, maintenance, and repairs records
- Publish results for fleet operators



# **Test Fleets**



- Transit Bus Evaluation Program
- Truck Test Fleets and the Truck Evaluation Project

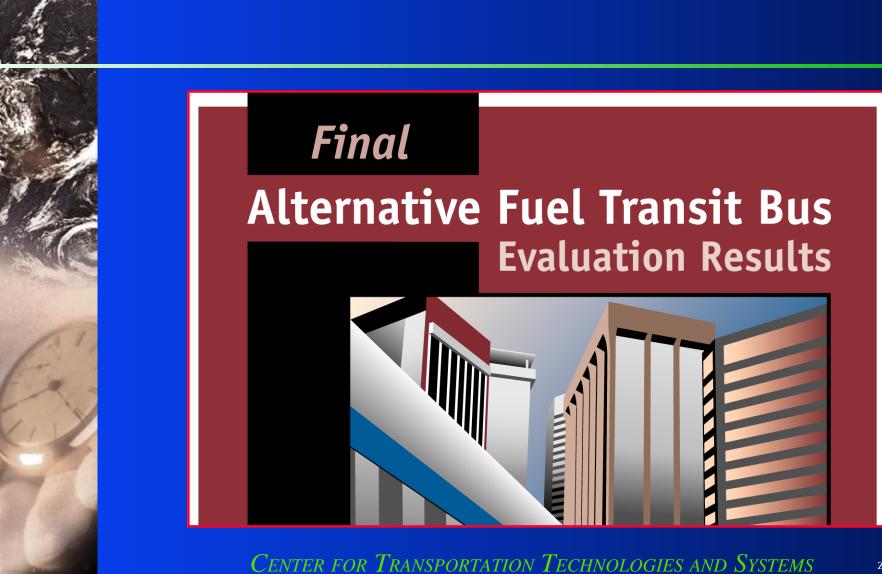


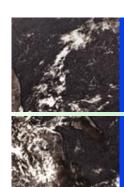
# **Transit Bus Evaluation Program**

- 115 buses at 8 sites
- LNG, CNG, methanol, ethanol, 20% biodiesel blend
- Closely matched diesel control buses
- 18 months of data at each site
- Battelle collects and reduces data
- Final report published in October 1996



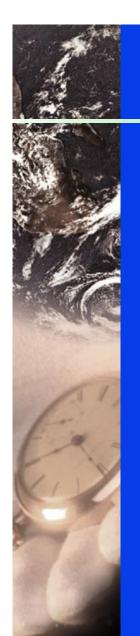
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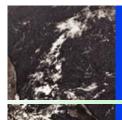
# **Transit Bus Evaluation Program Direction**

- Follow up on emissions from next-generation natural gas engines
  - Cummins L10 280G
  - DDC Series 50G
- Follow up on LNG bus development



# **Truck Test Fleets**

- Ethanol
- CNG
- New truck evaluation project



#### **Archer Daniels Midland Ethanol Line-Haul Trucks**



Number of trucks in project: 4 E95, 1 diesel control Chassis: White/GMC WIM64T Class 8 line-haul truck

Engine: Detroit Diesel 6V92TA

Fuel system: 95% ethanol with Lubrizol, two 120-gallon stainless steel tanks

Status: The trucks were operated from May of 1993 through 1996.



# Alternative Fuel TRUCKS

Case Studies



#### **Running Line-Haul Trucks** on Ethanol

By Paul Norton and Kenneth J. Kelly, NREL Norman J. Marek, Illinois DCCA

The Archer Daniels Midland Experience

magine driving a 55,000-pound tractortrailer that runs on corn! If you find it difficult to imagine, you can ask the truck drivers for Archer Daniels Midland (ADM) what it's like. For the past 4 years, they have

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# **Hennepin County and Nebraska Highway Department Ethanol Snow Plows**



Number of trucks in project: 4 E95, 1 diesel control

Chassis: Navistar F5070 dump truck Engine: Detroit Diesel 6V92TA

Fuel system: 95% ethanol

Status: Trucks have been in operation since April 1993.



### **New York City Department of Sanitation CNG Refuse Haulers**



Chassis: Crane Carrier refuse hauler, Class 8

Engine: Cummins L10-240G

Fuel system: CNG, five pressed steel tank company cylinders Status: Trucks have been in operation since October 1992.



# Alternative Fuel TRUCKS

Case Studies



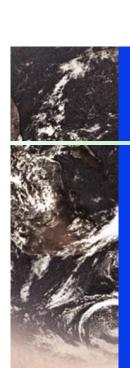
### **Running Refuse Haulers** on Compressed **Natural Gas**

By Paul Norton and Ken Kelly, NREL



Tn the fall of 1992, six new refuse haulers appeared on the streets of New York City, These trucks were different from any the city had seen before. Compared to their conventional brothers,

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# **Truck Evaluation Project**

- Based on the Transit Bus Program
- Stringent criteria including
  - At least five identical alternative fuel trucks
  - Closely matched controls
  - Site history of high-quality data acquisition
- Battelle will collect data
- Asked industry about relevant data and format
- Project guidelines published
- First two sites are under way



# Raley's Groceries LNG Line-Haul Trucks



Number of trucks in project: 8 CNG, 3 diesel controls

Chassis: Kenworth T800, Class 8 tractor

Engine: Cummins L10-300G

Fuel system: LNG, 2 100-gallon MVE tanks Status: Truck started operation in April 1997.



### Pima Gro Systems, Inc., CNG Line-Haul Trucks



Number of trucks in project: 5 CNG, 3 diesel controls

Chassis: White/GMC WG64T, Class 8 tractor

Engine: Caterpillar 3176BG dual-fuel

Fuel system: CNG, 3 Lincoln composite cylinders Status: First truck began service in February 1997.



#### **Program Participants**

The National Renewable Energy Laboratory (NREL)

The Trucking Research Institute of the American Trucking Associations

Battelle Memorial Institute

Acurex Environmental Corporation

West Virginia University

White Department of Comm

Illinois Department of Commerce and Community Affairs

University of Missouri

#### **Co-Sponsors**

Archer Daniels Midland

Iowa Soybean Association

Minnesota Corn Growers

Pacific Enterprises LNG

Power System Associates

Praxair (formerly Liquid

Carbonics)

Sacramento Metropolitan Air

Quality Management District

(SMAQMD)

South Coast Air Quality

Management District

(SCAQMD)

Southern California Gas

Company

#### **Truck Fleets**

Ag Processing

Archer Daniels Midland

Con-Way Western Express

Hennepin County, MN

**Houston Airgas** 

Los Angeles Times

Nebraska Highway Department

New York City Department of

Sanitation

**Orange County Sanitation** 

District

Ozark Trucking

Pima Gro Systems, Inc.

Praxair

Raley's Groceries

**Unocal Corporation** 

USA Waste/ William H. Martin

Wal-Mart Stores, Inc.



#### **Bus Fleets**

Bi-State Development Agency, St. Louis, MO GP Transit, Peoria, IL Houston Metro, Houston, TX Metro-Dade Transit Authority, Miami, FL Metropolitan Council of Transit Operations, Minneapolis/St. Paul, MN Pierce Transit, Tacoma, WA Triboro Coach Company, New York City, NY Tri-Met, Portland, OR

#### **Engine and Chassis Manufacturers**

BIA (Orion Bus)

Caterpillar

Crane Carrier

**Cummins Engine Company** 

**Detroit Diesel Corporation** 

Flxible

Ford Trucks

Freightliner

Gillig

Kenworth

Mack Trucks

Navistar

Peterbilt

Stewart & Stevenson

TMC (NOVA Bus)



# For More Information...



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# For More Information...

The AFDC World Wide Web address is http://www.afdc.doe.gov







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or visit our Web site:

http://www/afdc.doe.gov/1/trknews



# **Advanced Development Program Approach**

- Pre-production field development
- Test fleets